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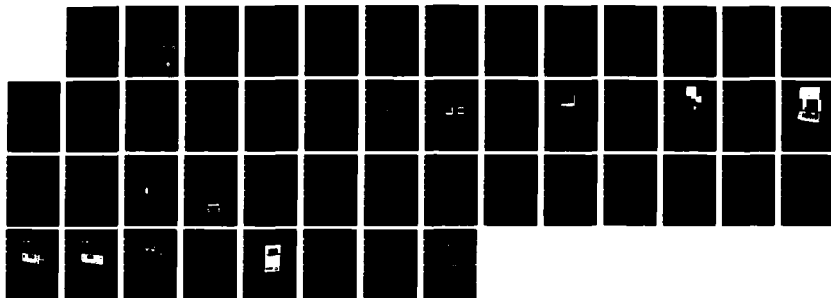
DENTAL PORCELAIN FURNACES: TEST AND EVALUATION(U)
SCHOOL OF AEROSPACE MEDICINE BROOKS AFB TX
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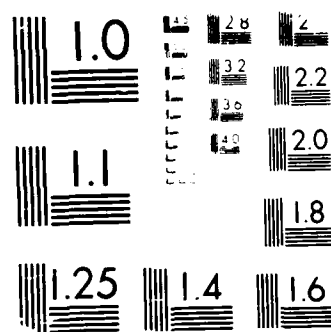
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DENTAL PORCELAIN FURNACES: TEST AND EVALUATION

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January 1988



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USAF SCHOOL OF AEROSPACE MEDICINE
Human Systems Division (AFSC)
Brooks Air Force Base, TX 78235-5301



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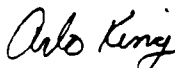
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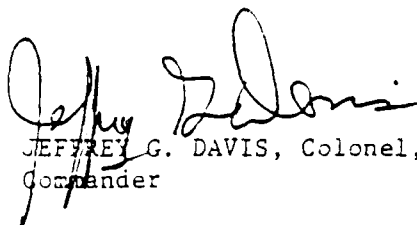
This report has been reviewed and is approved for publication.



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DENTAL PORCELAIN FURNACES: TEST AND EVALUATION

INTRODUCTION

Because of the wide selection of dental porcelain furnaces on the market and the resultant confusion, the Dental Investigation Service (DIS) undertook this study to offer USAF dental clinics information to aid them in their selection of the best unit for their particular requirements. This report compares the capabilities and features of these furnaces. The information from this report can be used by dental clinics to assist in the selection of porcelain furnaces to meet their particular requirements.

TEST METHODS

The evaluators grouped all porcelain furnaces (Table 1) into three categories: automatic (Table 2), manual (Table 3), and glazing (Table 4). They also arranged the vacuum pumps (Table 5) into a separate table. The following criteria were developed by USAFSAM evaluators to compare the units against the most desired and required features.

- Number of open programs: This capability allows the operator to program the number of user firing cycles. This capability does not include preprogrammed cycles such as calibration, idle, and purging cycles.
- Memory retained without a battery: This feature allows programmed information to be permanently stored in its memory, even if the unit is unplugged for an extended period.
- Muffle composition: There are two types of muffle composition -- ceramic and ceramic/quartz.
- Preprogrammed purging cycle: This feature allows units to have built-in purging cycles. The method will vary from one unit to the next. See the description booklet of each individual unit for the exact purging cycle.
- Air fire and raise temperature after releasing the vacuum: This feature allows the furnace to release vacuum at a given temperature and raise the temperature without vacuum.
- Separate temperature settings to close the muffle and start the vacuum: This capability allows the muffle to close at a given temperature and turn the vacuum on at a separate temperature. This setting is sometimes referred to as the "evacuation temperature."
- Self calibrating: This feature allows the units to have the capability of automatically setting or calibrating themselves at exactly 960 °C (1760 °F). The user replaces the firing tray with a tray in which there are two electrodes protruding from the top and a cord leading from the side which is plugged into a jack located somewhere on the furnace. Silver wire is wrapped around and then between the electrodes. The user begins the program and the test is completed automatically.

- Programmed night mode: This feature allows the user to enter a program which closes the muffle and maintains a given temperature. Some units will also place the muffle under vacuum.
- End of program override: This feature is frequently necessary to immediately refire a restoration as in the case of glazing or post soldering. End of program override allows the user to quickly close the muffle and raise the temperature either with or without vacuum.
- Slow cooling cycle: This feature allows the units to be removed slowly from the muffle following the firing cycle.
- Monitor all firing information simultaneously: This option allows the user to read all firing parameters, present temperature, and vacuum at the same time.
- View window: This feature allows the user to observe while glazing and post soldering. This window may or may not be magnified.
- Firing information altered while the program is running: This feature allows the user to alter the firing parameters while the program is in progress. This feature is very limited on all units.
- Able to label the type of porcelain/metal used: This feature allows the user to label the type of porcelain/metal on the video screen.
- Light outside the muffle: This feature allows a light to be turned on at the muffle opening for inspection of the restorations immediately after a firing cycle.
- May be converted from Fahrenheit to Celsius: This feature allows the furnace to convert all programmed cycles between Fahrenheit and Celsius thermometric scales at the push of a button. Some units may also convert vacuum pressure between inches Hg (in. Hg) and millimeter Hg (mm Hg). Several units which do not use Light Emitting Diode (LED) readouts use gauges with scales for Fahrenheit and Celsius.
- The pump turns off when the required vacuum is reached: This feature turns the vacuum pump off once the vacuum has been reached. Furnaces which turn the vacuum pump off normally sense when the pressure has dropped to a certain level and will turn the vacuum back on.
- Program diagnostic system: This feature allows the furnace to sense problems with the firing cycle. These indicators may include programming in data which exceeds the limits of the furnace, contradiction in firing data, faulty calibration procedures, vacuum leaks, or a firing door that will not close completely.
- Maximum firing temperatures: This capability allows the furnace to maintain maximum temperatures. Some units will require an additional computer chip to reach these maximum temperatures. A high temperature of 1170 °C (2138 °F) is required for the Vita Hi-Ceram all-porcelain system.

- Maximum temperature rise per minute: This temperature is the maximum rate the furnace will rise in temperature.
- Available voltages: All ovens should be available in 50/60 Hz for each voltage.
- Recommended amperage for a dedicated line: It is recommended that all units use a dedicated line with a minimum amperage. Amperages listed are for the lowest voltage.
- Government price as of 1 July 1987: This price should be the current government or GSA price. Manufacturers should always be contacted for current prices before ordering. Prices do not include the vacuum pump.

TABLE 1. PORCELAIN FURNACE AND VACUUM PUMP SOURCES

Manufacturer	Porcelain Furnace	Distributor
Dentsply	Multimat 99 Dentsply Vacuum Pump	Dentsply International 570 West College Ave P.O. Box 872 York, PA 17405 717-845-7511
Jelenko	Flagship II VPF Flagship Series B VPF Commodore VPF Tru-Fire VPF Auto Glazer Jelcraft Vacuum Pump	J.F. Jelenko & Company 99 Business Park Drive Armonk, NY 10504 1-800-431-1785
Jelrus	Alpha PC Megastar Glaze-A-Mat Cera-Mat S Vacuum Pump	Jelrus Dental Products Corp 2020 Jericho Turnpike New Hyde Park, NY 11040 1-800-221-6721 outside NY 516-775-1645 inside NY
New York Dental	Compu-Matic CPF Vacuum Pump	New York Dental Mfg. Div. New York Controls Inc. 795 East 135th Street Bronx, NY 10454 212-993-8324/8325
Ney	Sun Fire 40 Mark III Model 660 Miniglaze/2 Super-vac Pump	J.M. Ney Company Ney Industrial Park Bloomfield, CT 06002 1-800-243-1942

TABLE 1. PORCELAIN FURNACE AND VACUUM PUMP SOURCES (continued)

Manufacturer	Porcelain Furnace	Distributor
Unitek	Ultra-Mat CDF Ultra-Mat II Vacuum Pump	Unitek Corporation 2724 South Peck Road Monrovia, CA 91016 1-800-423-4588
Vita	Vacumat 200 Vacumat 100 Vacuum Pump	Vident 5130 Commerce Drive Baldwin Park, CA 91703 1-800-828-3839 outside CA 1-800-344-1911 inside CA

TABLE 2. AUTOMATIC PORCELAIN FURNACE EVALUATION

Feature	Jelenko Flagship II VPF	Unitek Ultramat CDF	Jelrus Alpha PC	Vita Vacumat 200	Ney Sun Fire 40	Jelenko Flagship Series B VPF
Number of open programs	45	30	50	80	40	38
Memory retained without a battery	yes	yes	yes	yes	yes	no
Muffle composition	ceramic	ceramic	ceramic	ceramic/ quartz	ceramic/ quartz	ceramic
Preprogrammed purging cycle	yes	no	yes	no	yes	yes
Programmable idle program	yes	no	limited ^a	limited ^b	limited ^c	yes
Air fire and raise the temper- ature after releasing the vacuum	yes	yes	yes	no	yes	yes
Separate temperature settings to close the muffle and start the vacuum	yes	no	yes	no	no	yes
Self calibrating	yes	no	yes	no	yes	yes
Programmed night mode	yes	yes	yes	no	yes	yes
End of program override	yes	no	yes	no	yes	yes
Slow cooling cycle	yes	yes	yes	yes	yes	yes
Monitor all firing information simultaneously	yes	yes	yes	yes	limited ^d	limited ^e
View window	yes	yes	no	no	yes	yes
Firing information altered while program is running	limited ^f	limited ^g	limited ^h	no	limited ⁱ	limited ^f

TABLE 2. AUTOMATIC PORCELAIN FURNACE EVALUATION (continued)

Feature	Jelenko Flagship II VPF	Unitek Ultramat CDF	Jelrus Alpha PC	Vita Vacumat 200	Ney Sun Fire 40	Jelenko Flagship Series B VPF
Able to label the type of porcelain/metal used	limited ^J	yes	no	no	no	no
Light outside the muffle	yes	no	no	no	no	yes
May be converted from Fahrenheit to Celsius thermometric scale	yes	yes	yes	no	yes	yes
The pump turns off when required vacuum is reached	yes	yes	yes	no	yes	yes
Program diagnosis system	yes	yes	yes	yes	yes	yes
Self diagnosis system	yes	no	yes	yes	yes	yes
Maximum firing temperature	1150 °C 2102 °F	1204 °C 2199 °F	1204 °C 2199 °F	1200 °C 2192 °F	1150 °C 2102 °F	1150 °C 2102 °F
Maximum temperature rise per minute	165 °C 329 °F	120 °C 218 °F	204 °C 400 °F	250 °C 482 °F	93 °C 200 °F	165 °C 329 °F
Available voltages (V)	100 115 230	100 115 220 240	100 115 220 240	110 220 240	115 230	100 115 230
Recommended amperage (amp) (lowest voltage) for a dedicated line	15	12	15	NA	20	15
Government price as of 1 July 1987	\$4675.00	\$4995.00 (includes pump)	\$3216.50	\$3995.00 (includes pump)	\$2695.00	\$3311.00

TABLE 2. AUTOMATIC PORCELAIN FURNACE EVALUATION (continued)

Feature	Dentsply Multimat 99	New York Dental Compu-Matic	Vita Vacumat 100	Jelenko Commodore VPF	Jelrus Mega- Star	Unitek Ultra- Mat II
Number of open programs	99	30	9	10	10	6
Memory retained without a battery	yes	yes	yes	yes	yes	NA ^k
Muffle composition	ceramic	ceramic	ceramic/ quartz	ceramic	ceramic	ceramic
Preprogrammed purging cycle	yes	yes	no	no	yes	no
Programmable idle program	yes	yes	no	yes	yes ^l	yes
Air fire and raise the temperature after releasing the vacuum	yes	yes	no	yes	yes	no
Separate temperature settings to close the muffle and start the vacuum	yes	no	no	yes	yes	no
Self calibrating	yes	yes	no	yes	yes	no
Programmed night mode	yes	yes ^m	no	yes	yes	no
End of program override	yes	yes	no	yes	yes	no
Slow cooling cycle	yes	yes	yes	yes	yes	yes
Monitor all firing information simultaneously	yes	no	yes	limited ^e	limited ⁿ	limited ^o
View window	no	no	no	yes	no	no
Firing information altered while program is running	yes	no	no	limited ^f	no	yes

TABLE 2. AUTOMATIC PORCELAIN FURNACE EVALUATION (continued)

Feature	Dentsply Multimat 99	New York Dental Compu-Matic	Vita Vacumat 100	Jelenko Commodore VPF	Jelrus Mega- Star	Unitek Ultra- Mat II
Able to label the type of porcelain/metal used	no	no	no	no	no	no
Light outside the muffle	no	no	no	yes	no	no
May be converted from Fahrenheit to Celsius thermometric scale	yes	no	no	yes	yes	no
Pump turn off when required vacuum is reached	yes	yes	no	yes	yes	no
Program diagnosis system	no	yes	yes	yes	yes	no
Self diagnosis system	yes	no	yes	yes	yes	yes
Maximum firing temperature	1200 °C 2192 °F	1204 °C 2199 °F	1180 °C 2156 °F	1150 °C 2102 °F	1204 °C 2199 °F	1200 °C 2192 °F
Maximum temperature rise per minute	200 °C 392 °F	204 °C 400 °F	250 °C 482 °F	165 °C 329 °F	204 °C 400 °F	55 °C 131 °F
Available voltages (V)	115 220	110 220	110 220 240	100 115 230 240	100 110 220 240	100 115 220
Recommended amperage (amp) (lowest voltage) for a dedicated line	13	15	8	15	15	13
Government price as of 1 July 1987	\$2246.25	\$3000.00	\$3391.15 (includes pump)	\$2461.00	\$2516.50	\$3119.50 (includes pump)

Footnotes for Table 2:

- ^aThe Alpha PC will automatically idle at 538 °C (1000 °F) unless you have selected a starting low temperature below 538 °C (1000 °F), then the furnace will idle at your selected low temperature.
- ^bThe initial starting or idling temperature may be altered; however, it will change the starting temperature of all the programs.
- ^cDepressing the "ON/IDLE" key will maintain the oven temperature at 112 °C (234 °F).
- ^dFiring parameters may be viewed while the program is running by pushing the individual keys.
- ^eWhile running a program, only temperature and vacuum readings will show up on the LED screen; however, program parameters may be viewed at any time by depressing the "PROGRAM" and "STEP" keys.
- ^fIn-cycle parameter changes are limited depending on how far the program has progressed.
- ^gAdditional features include the ability to adjust the high temperature while the program is in progress. Each time the "UP" key is pushed the high temperature is raised 1 degree.
- ^hIn-cycle parameter changes are limited to raising the vacuum release temperature and the high temperature. This change is accomplished by depressing the "OVERRIDE" button one time for each degree.
- ⁱThe use of in-cycle parameter changes is limited as only the maximum firing temperature may be increased.
- ^jThe labeling of programs is limited to function, not porcelain or metal type. Example: OPAQUE 1, OPAQUE 2, BODY 20, etc.
- ^kThis unit does not have a memory and all gauges are read in Celsius thermometric scale only.
- ^lThe Megastar will automatically idle at 538 °C (1000 °F) unless you have selected a starting low temperature below 538 °C (1000 °F), then the furnace will idle at your selected low temperature.
- ^mA night mode is provided; however, it is unrestricted and must be programmed by the operator.
- ⁿThe program number, muffle temperature, and vacuum level may be monitored throughout the firing cycle. Actual program parameters may be viewed at any time by depressing the "ENTER/REVIEW" key.
- ^oProgramming information which may be viewed include actual temperature and vacuum only. Low- and high-temperature set points may be checked at any time during the cycle by momentarily pressing the "LOW" or "HIGH" temperature set switches.

TABLE 3. MANUAL PORCELAIN FURNACE EVALUATION

Feature	Jeirus Cera-		Jelenko		Ney	
	Mac-S		Tru-Fire VPF	Mark III	Model 660	
Muffle composition	ceramic		ceramic	ceramic	ceramic	
Air fire and raise temperature after releasing the vacuum	yes		yes	yes	yes	
Self calibrating	no		yes	no	no	
Monitor all firing information simultaneously	yes		no	yes	yes	
View window	no		no	yes	yes	
Light outside the muffle	no		yes	no	no	
Able to read in Fahrenheit or Celsius thermometric scale	yes		yes	yes	yes	
Program diagnostic system	no		yes	no	no	
Self diagnosis system	no		yes	no	no	
Maximum firing temperatures	1150 °C 2102 °F		1150 °C 2102 °F	1454 °C 2650 °F	1454 °C 2650 °F	
Available voltages (V)	100 115 230		100 115 230	115 220	115 220	
Maximum temperature rise per minute	49 °C 125 °F		165 °C 329 °F	204 °C 400 °F	204 °C 400 °F	
Recommended amperage (amp) (lowest voltage) for a dedicated line	15		15	15	15	
Government price as of 1 July 1987	\$1225.00		\$1696.00	\$1106.00*	\$ 857.50*	

TABLE 4. GLAZING PORCELAIN FURNACE EVALUATION

Feature	Jelrus Glaze-A-Mat	Jelenko Auto Glazer	Ney Mini Glaze
Does the furnace have to be slowly dried out after the unit has been turned off	no	yes	yes
End of program override	yes	yes	yes
Muffle composition	ceramic	ceramic	ceramic
View window	no	no	yes ^a
Light outside the muffle	yes	no	no
Time for heat soaking	yes	no	no
Maximum firing temperature	1093 °C 2000 °F	1093 °C 2000 °F	1093 °C 2000 °F
Maximum temperature rise	116 °C 240 °F	120 °C 248 °F	66 °C 150 °F
Available voltages (V)	115 230	100 115	115 220
Recommended amperage (amp) (lowest voltage) for a dedicated line	15	15	6.5 ^b
Government price as of 1 July 1987	\$626.50	\$638.00	\$301.00

^aMust be purchased separately

^bRated at 750 watts

TABLE 5. VACUUM PUMP EVALUATION

Feature	Noy Vacuum Pump	Vita Vacuum Pump	Jelrus Vacuum Pump	Unitek Vacuum Pump	Jelenko Jelcraft Pump	New York	
						Dental Vacuum Pump	Dentsply Vacuum Pump
Electrical plug allows the pump to be used on any brand of porcelain furnace	yes	no	yes	yes	yes	yes	yes
Sound level (dB) from a 1.52 m (5 ft) distance	NA*	50	66	66	61.8	NA*	NA*
Maintenance free	no	yes	yes	yes	no	no	no
Available voltages (V)	115 230	110 220 240	110 220 240	115 220 240	110 115 230	110 220	115 220
Government price as of 1 July 1987	\$251.20	\$327.25	\$308.00	\$409.50	\$276.00	\$250.00	\$287.00

 *Pump's sound level was below the sensitivity of the sound meter

DISCUSSION

Jelenko Flagship II VPF

The Jelenko Flagship II VPF (Fig. 1) is a computerized programmable porcelain furnace with 45 open programs. This unit has a large detachable cathode-ray tube (CRT) screen which shows all necessary firing information and data. All commands are relayed to the operator verbally or may be switched to tone commands. The vertical muffle is a conventional ceramic material which includes a viewing window with an exterior light. The unit tested included an optional hand-held remote control keypad which contains all the controls found on the front of the furnace.

Calibration is accomplished automatically. The normal firing tray is replaced with one that has two electrodes protruding from the top. Silver wire is wrapped around and then between the electrodes. A cord from the side of the firing tray is then plugged into a calibration jack. The calibration program will first allow the user to enter the month and day which is recorded for future reference. The furnace will automatically raise the door and the temperature will rise until the silver melts. The furnace is then automatically set at 960 °C (1760 °F), and the actual temperature adjustment that took place is displayed on the screen.

This unit is easy to program and operate. All programs are menu driven and arranged in a logical sequence. Programming parameters allow for a wide use of alloys and porcelains. The programming screen (Fig. 2) includes all the necessary information and is displayed numerically and graphically. This unit allows the operator to close the muffle at a given temperature and turn the vacuum on at a different temperature as directed by some porcelain manufacturers. The labeling of programs is limited to function, not porcelain or metal type. Example: OPAQUE 1, OPAQUE 2, BODY 20, etc.

Additional features include an override operation. This feature allows the user, at the end of a firing cycle, to automatically close the oven door and raise the temperature an additional 37.8 °C (100 °F) with or without vacuum. In-cycle parameter changes are limited depending on how far the program has progressed. An idle program which may be used either with or without vacuum is part of the unit. The automatic night program will maintain the furnace temperature at 310 °C (590 °F), and the vacuum pump will run for 1 min and then turn off. The automatic purging program takes the temperature from 704 °C (1300 °F) to 1038 °C (1900 °F) under vacuum and holds for 2 min. At that time the unit is vented, the vacuum is restored for an additional 2 min, the oven is vented, and the program is complete.

This unit has a self-diagnostic system which continuously monitors the vital functions of the furnace. Malfunction displays appear on the CRT screen and corrective action must be taken. Displays include central processing unit (CPU) malfunction (malfunction of the control circuit board), excess temperature, platform malfunction, heater malfunction, vacuum malfunction, calibration malfunction, and thermocouple malfunction.

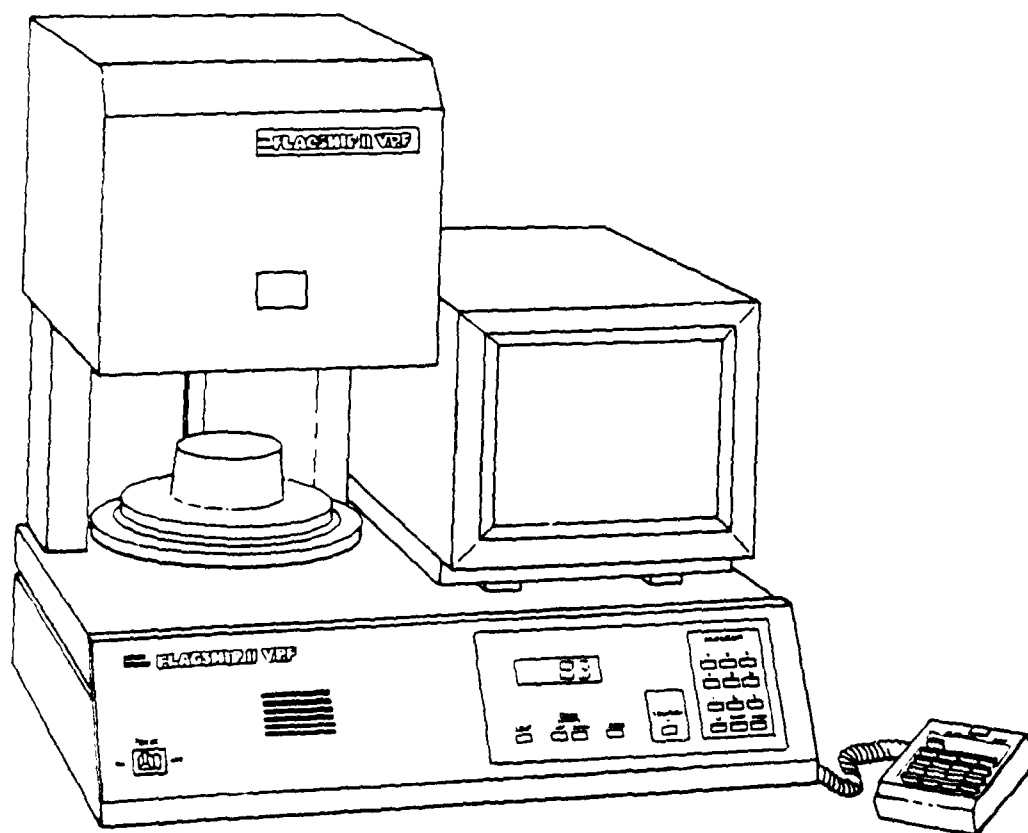


Figure 1. Jelenko Flagship II VPF.

[1]

PUSH START BUTTON

1	PREHEAT TIME	5min 0sec
2	LOW TEMP	1300 °F
3	HEAT RATE	100 °F/min
4	VACUUM LEVEL	-27 inHG
5	HIGH TEMP	1800 °F
6	HOLD TIME	1min 0sec
7	COOL TIME (3)	1min 0sec
8	EVACUATION TEMP	1350 °F
9	VENT TEMP	1750 °F
10	VENT TIME	0min 0 sec

Figure 2. Programming screen.

This unit would be best suited in any dental laboratory which fabricates all types of metal ceramic restorations. The 45 open programs would support the continual processing of multiple types of porcelains and alloys, but is not necessary for laboratories producing a great deal of procedures using one type of porcelain and alloy system. The number of features of this unit is lengthy, some of which may or may not be beneficial. The optional keypad would not be a requirement.

Unitek Ultra-Mat CDF

The Unitek Ultra-Mat CDF (Fig. 3) is a computerized programmable porcelain furnace with 30 open programs. The vertical muffle is a conventional ceramic material and includes a magnified viewing window with an interior light for post soldering. This unit has a video screen relaying all information to the operator. All programming is completed through a small keyboard located under the video screen.

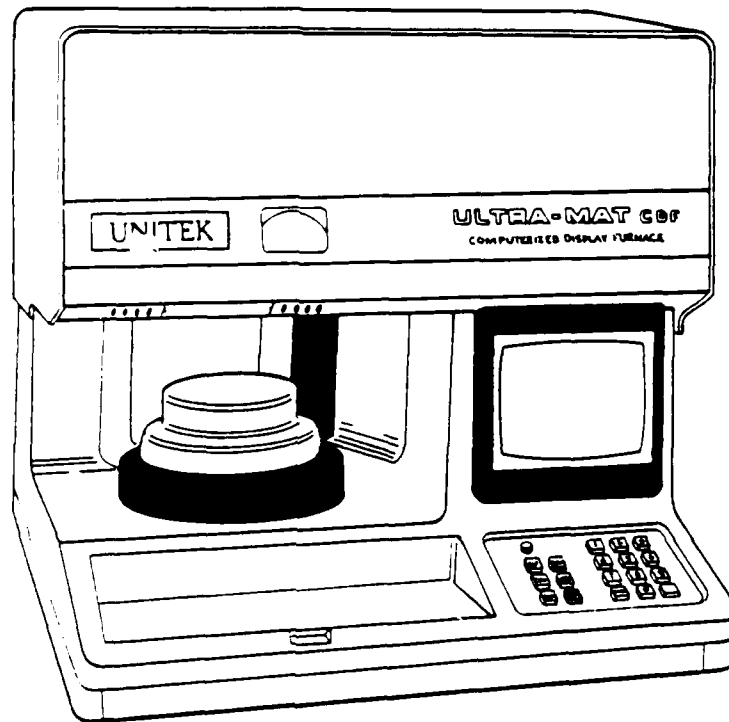


Figure 3. Unitek Ultra-Mat CDF.

This unit is the easiest to program of all the furnaces tested. All programming is menu driven and easy to operate. The initial screen (Fig. 4) shows all available programs. The type of porcelain is selected, then the process. The user selects "ENTER" and all firing information (Fig. 5) is viewed as well as present furnace temperature, vacuum pressure, and instructions to press "START" when ready. Editing is accomplished by typing in the desired program and selecting the "EDIT" mode. This furnace is the only oven tested which allows the operator to program in the actual porcelain type and firing process.

Additional features include the ability to adjust the high temperature while the program is in progress. Each time the "UP" key is pushed the high temperature is raised 1 degree. The furnace is easily converted from Fahrenheit to Celsius by changing a switch located under a metal plate on the front of the furnace. All firing information is automatically converted. Selecting the night mode raises the firing table, the video screen will go black, and furnace will idle at 150 °C (302 °F).

PORCELAIN	PROCESS
1 UNITEK	1 OPAQUE BAKE
2 BRAND X	2 BODY BAKE-PRECIOUS
3 BRAND Y	3 BODY BAKE-NON-PREC
4 BRAND Z	4 SLO GLAZE-PRECIOUS
	5 SLO GLAZE-NON-PREC
	6 FAST GLAZE
PORCELAIN	PROCESS
4 OPEN	7 OPEN
5 OPEN	8 OPEN
*****OTHER PROCESSES*****	
61 MARGIN PORCELAINS	64 SOLDER MODE
62 OXIDIZE	65 TABLE UP
63 SILVER CALIBRATE	66 NIGHT MODE
NEED INSTRUCTIONS?	PUSH HELP KEY
499 DEG.	PROG.NO. 11, ENTER

Figure 4. Initial screen.

```

13 UNITEK, BODY BAKE, NON PREC
-----DEG=C
LOW TEMPERATURE      650 DEGREES
ENTRY TIME           5.5 MINUTES
VACUUM LEVEL         720 MM HG
VAC RELEASE TEMP     970 DEGREES
HIGH TEMPERATURE     940 DEGREES
TEMPERATURE RATE      55 DEG/MIN
TIME AT TEMP         0.0 MINUTES
REMOVAL TIME         0.3 MINUTES
-----
FURNACE TEMP         497 DEGREES
CHAMBER VACUUM       - 08 MM HG
ACTUAL TEMPERATURE RATE  DEG/MIN

```

PRESS START WHEN READY

Figure 5. Firing information.

This unit would be best suited in any dental laboratory which fabricates all types of metal ceramic restorations. The 30 open programs would support the continual processing of multiple types of porcelains and alloys, but is not necessary for laboratories producing a great deal of procedures using one type of porcelain and alloy system. The capability to label porcelain types and processes would be helpful by preventing the user from constantly referring to a log book.

Jelrus Alpha PC

The Jelrus Alpha PC (Fig. 6) is a computerized programmable porcelain furnace with 50 open programs. This unit has a large easy-to-read video screen showing all firing information at a glance. The keyboard is found directly below the video screen and is easy to operate. The vertical muffle is a conventional ceramic material which offers a rapid heat-up and cool-down period.

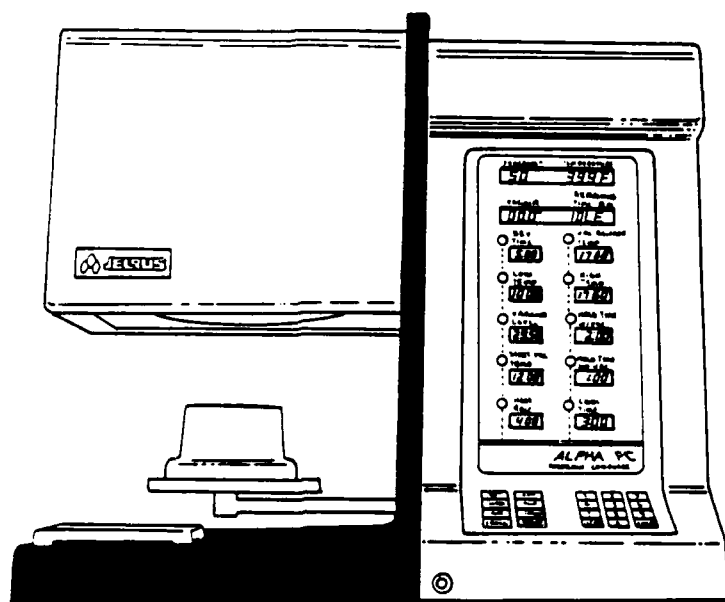


Figure 6. Jelrus Alpha PC.

Calibration is accomplished automatically. The normal firing tray is replaced with one that has two electrodes protruding from the top. Silver wire is wrapped around and then between the electrodes. A cord from the side of the firing tray is then plugged into a calibration jack. After the calibration program has started, there is a 10-min heat soak period at 704 °C (1300 °F) followed by the temperature rising until the silver melts. At that point the furnace is automatically calibrated at 960 °C (1760 °F).

This unit is easy to program. The user types in the desired program and pushes the "EDIT" button. A small red light will appear along the side of each entry. The user programs in the desired information and pushes the "ENTER" button. The red light will then come on at the next entry and the process is repeated. Included in the programming options is the ability to select full vacuum, no vacuum or any entry between 10.0 in. Hg to 28.0 in. Hg. A separate setting is provided for low temperature and start vacuum temperature. This setting allows the user to close the muffle door, raise the temperature, and start the vacuum at a given temperature. Any limits which have been exceeded are relayed to the operator for correction. Because programs may not be labeled but are only numbered (1-50), a log book is provided to aid in keeping track of program information.

Additional features include an override operation. This feature allows the user, at the end of a firing cycle, to automatically close the oven door and raise the temperature 1 degree for each time the "OVERRIDE" button is pushed. In-cycle parameter changes are limited to raising the vacuum release temperature and the high temperature. This change is accomplished by depressing the "OVERRIDE" button one time for each degree. This unit will also automatically idle at 538 °C (1000 °F) unless you have selected a starting low temperature below 538 °C (1000 °F); then the furnace will idle at your selected low temperature. The automatic night mode may be used by itself or it may be programmed into the end of a firing cycle. Using this feature

allows the operator to fire a restoration and have the furnace automatically shut itself down. The decontamination program takes the temperature from 649 °C (1200 °F) under full vacuum to 1093 °C (2000 °F) with a hold time of 10 min.

This unit has a complete self-diagnostic system which continuously monitors all functions. Programming or system malfunctions appear on the video screen for corrective action. Displays include invalid entry, invalid program number, check vacuum, check door, do silver calibration, check silver wire, do vacuum calibration, power failure, check set values, open TC (faulty thermocouple), muffle/open (replace muffle), and replace Triac.

This unit would be best suited in any dental laboratory which fabricates all types of metal ceramic restorations. The 50 open programs would support the continual processing of multiple types of porcelains and alloys, but is not necessary for laboratories producing a great deal of procedures using one type of porcelain and alloy system. The cost of this unit is below the price of most other units which are similar.

Vita Vacumat 200

The Vita Vacumat 200 (Fig. 7) is a computerized programmable porcelain furnace with 80 open programs. This unit has a vertical muffle in which the heating element is enclosed in a quartz tube. All firing information is relayed to the operator through a large LED readout located on the front of the furnace. Programs are entered through the small keypad on the front of the unit. A vacuum pump is included in the price of the furnace.

The muffle design of the Vita furnaces is unique to all others on the market. Because the heating coil is completely enclosed in a quartz tube and considerably thicker than other types, there is a great reduction of thermal stress in the coil. This design improves the durability and protects the filament from vapors and oxide formation. Because of this type of muffle design, the manufacturer claims that the need for calibration is not required. The instructions for calibration are not included in the manufacturer's instructions but may be obtained by contacting Vident. In our opinion this type of muffle design offers the most advantages.

All programming is accomplished through a small keypad located on the front of the unit. Inputting program data is fairly simple with a large LED readout. There are 80 open programs with some limitations as each number grouping will offer a different firing sequence. Example: programs 10-19 will heat up to a given end temperature in as short a time as possible (nonprogrammable), followed by continued firing at the end temperature for a set time, programs 50-59 will predry for a given time; then heat up to a set end temperature in a given time, all followed by continued firing at the end temperature for a set time. Programs may not be labeled within the furnace; however, a small program book is provided for logging in data.

The initial starting or idling temperature may be altered; however, it will change the starting temperature of all the programs. With this unit there is no means for releasing the vacuum at a given temperature and raising the temperature while air firing.

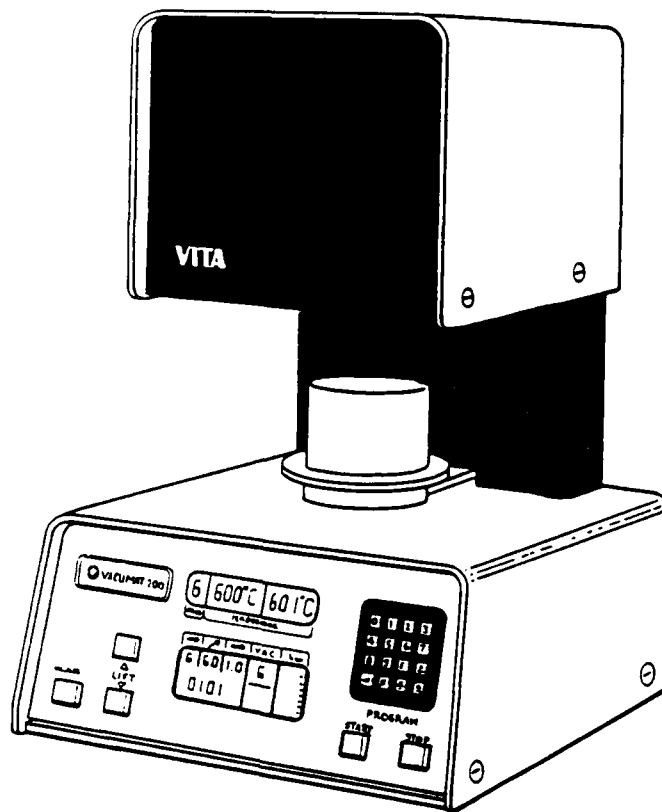


Figure 7. Vita Vacumat 200.

Additional features include the use of a manual control for raising and lowering the firing tray. The maximum firing temperature of this furnace is 1200 °C (2192 °F) which is necessary for laboratories using the Vita Hi-Ceram material. Following a firing cycle the furnace may be rapidly cooled down by turning on the vacuum pump. This feature will allow for a rapid turn-around time in large laboratories.

This unit has a self-diagnostic system which gives notice of certain malfunctions and misprogrammings. Indicators include the programming of times and temperatures which exceed the capability of the furnace, thermocouple failure, temperature in firing chamber has exceeded 1200 °C (2192 °F), and leakage in the vacuum system.

This furnace has a unique plug for the vacuum pump which requires the use of a Vita vacuum pump which is included. Provided accessories include a firing tray, a pair of 25-cm tweezers, a power lead complete with plugs, 6 crown stands, 2 porcelain trays, a personalized program handbook, operating instructions, and a firing chart.

This unit would be best suited in any dental laboratory which uses primarily Vita porcelains. The 80 open programs would support the continual processing of multiple types of porcelains such as VMK 68, Vitadur-N, and Vita Hi-Ceram; but is not necessary for laboratories producing a great deal of procedures using one type of porcelain and alloy system. This is an excellent unit; but because the setting of the low temperature changes the

low temperature of all 80 programs and there is no capability to release the vacuum and raise the temperature at the end of the firing cycle, the use of some types of porcelains would require a modification of their processing.

Ney Sun Fire/40

The Ney Sun Fire/40 (Fig. 8) is a computerized programmable porcelain furnace with 40 open programs. This unit has a ceramic/quartz vertical muffle with a viewing window. The firing platform is extremely large and operated smoothly. All programming is completed through a keypad which is located on the front panel of the furnace.

Calibration is accomplished automatically. The normal firing tray is replaced with one that has two electrodes protruding from the top. Silver wire is wrapped around and then between the electrodes. A cord from the side of the tray is then plugged into a calibration jack. After the program has started, the furnace will slowly raise the door, and the temperature will rise until the silver melts. The furnace is then automatically set at 960 °C (1760 °F) and all programs are adjusted. The temperature rise is slow and resulted in an accurate calibration. Other units tested had a rapid temperature rise and the silver frequently ended up in a ball; however, this unit only slightly melted the silver wire.

There are 40 open programs which allow for a wide variety of porcelains and alloys. All firing information is programmed in through a small keypad on the front of the oven. The desired program number is typed in. At that time, changes may be made in the parameters or the start button is pushed to begin the program. Firing parameters may be viewed while the program is running by pushing the individual keys. Actual temperature and vacuum may be viewed individually by depressing the "TEMP/VACUUM" key. The use of in-cycle parameter changes is limited as only the maximum firing temperature may be increased. Caution must be used, as depressing the temperature increase key before the maximum temperature is reached will stop the program at that point and the hold time will begin. The only way the temperature will increase is by continually depressing the key. Depressing the "ON/IDLE" key will maintain the furnace temperature at 112 °C (234 °F). Following the completion of a program the temperature will idle at the "LOW TEMP" setting. Each program may not be labeled within the furnace; however, a small log book is provided.

Additional features include a muffle that is lined with quartz. This design offers an excellent heat transfer to the units and protects the heating element from contamination. This unit has an automatic 3-h decontamination cycle and the ability to switch back and forth from Celsius to Fahrenheit thermometric scale. The instruction book is the most complete of all the units evaluated. The book contains detailed information on all parts of the unit and an excellent troubleshooting chart.

This unit has a complete diagnostic system which tells the operator of faulty programming or furnace malfunctions. Error codes include programming mistakes, low vacuum, no heat (faulty muffle), no vacuum, faulty calibration process, and when the temperature in the muffle exceeds 1232 °C (2250 °F).

Routine maintenance includes periodic temperature and vacuum calibration, general cleaning, muffle decontamination (frequency depends on the type of alloy used), and column bearing lubrication every 12 months.

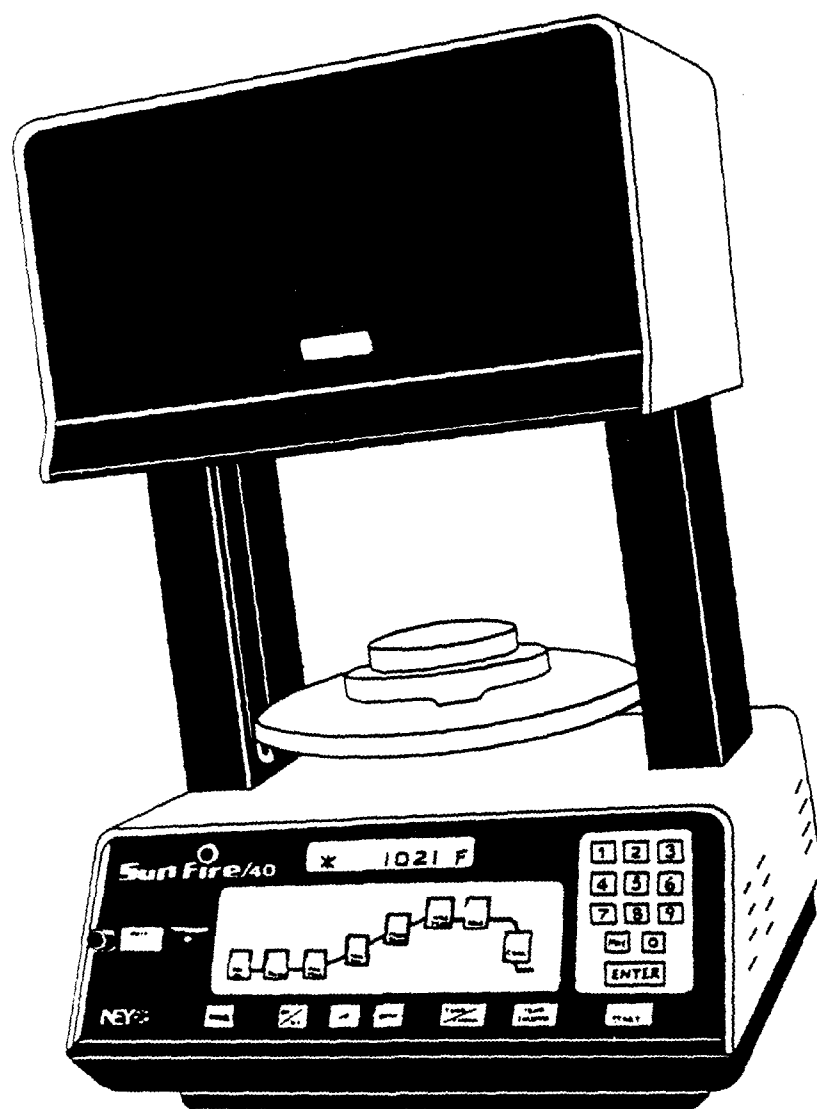


Figure 8. Ney Sun Fire/40.

This unit would be best suited in any dental laboratory which fabricates all types of metal ceramic restorations. The 40 open programs would support the continual processing of multiple types of porcelains and alloys, but is not necessary for laboratories producing a great deal of procedures using one type of porcelain and alloy system.

Jelenko Flagship Series B VPF

The Jelenko Flagship Series B VPF (Fig. 9) is a computerized porcelain furnace with 38 programmable firing cycles. A large LED readout with a simple-to-use keyboard is located on the front of the furnace. The muffle is a conventional ceramic material that includes a viewing window with an exterior light.

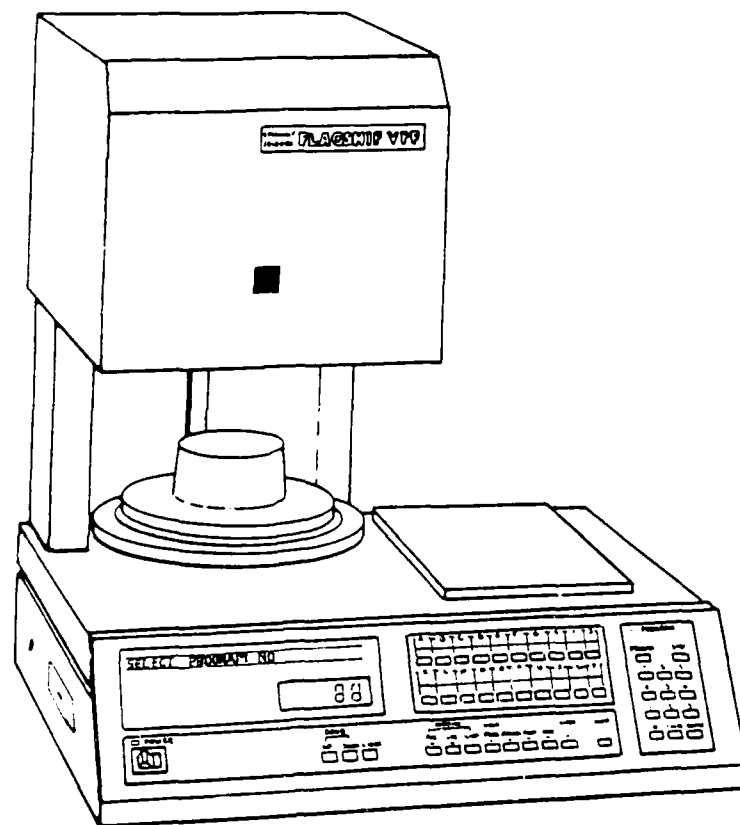


Figure 9. Jelenko Flagship Series B.

Calibration is accomplished automatically. The normal firing tray is replaced with one that has two electrodes protruding from the top. Silver wire is wrapped around and then between the electrodes. A cord from the side of the firing tray is plugged into a calibration jack; the furnace will automatically raise the door and the temperature will rise until the silver melts. The furnace is then automatically set at 960 °C (1760 °F), and all programs are adjusted.

This unit is easy to program. The operator has the option to program in an evacuation temperature which will close the oven door at a given temperature and turn on the vacuum at another temperature. If two similar programs are desired, programs may be copied from one to the next. If at any time errors are programmed into the unit, error messages will appear and corrective action must be taken. While running a program, only temperature and vacuum readings will show up on the LED; however, program parameters may be viewed at any time by depressing the "PROGRAM" and "STEP" keys. This unit was the only one evaluated which uses a battery to retain the program information in case of power interruption. The life span of the battery is rated at 4 years, and recommended replacement is every 2 years. Note: Battery must be purchased through the manufacturer.

Additional features include an override operation. This feature allows the user, at the end of a firing cycle to automatically close the oven door and raise the temperature an additional 37.8 °C (100 °F) with or without vacuum. In-cycle parameter changes are limited depending on how far the

program has progressed. The unit is also provided with a fixed or programmable idle program. The fixed program will maintain the furnace temperature at 610 °C (1130 °F), without vacuum, with the door closed. The user-created fixed program allows the user to set the temperature either with or without vacuum. The automatic night program will maintain the furnace temperature at 310 °C (590 °F); the vacuum pump will run for 1 min and then turn off. This furnace may be easily switched from Celsius to Fahrenheit which will change all the program information. The automatic purging program takes the temperature from 704 °C (1300 °F) to 1038 °C (1900 °F) under vacuum and holds for 2 min. At that time the furnace is vented, the vacuum is restored for an additional 2 min, the oven is vented, and the program is complete.

This unit has a self-diagnostic system which continuously monitors the vital functions of the furnace. Malfunction displays include CPU malfunction (malfunction of the control circuit board), excess temperature, platform malfunction, heater malfunction, vacuum malfunction, calibration malfunction, and thermocouple malfunction. The provided accessories include a set of 3 single point sagger trays, a set of 2 crown sagger trays, full arch sagger trays, calibration kit, door platform, and a manual door crank handle.

This unit operates off a dedicated line of 15 amps and has a safeguard feature which will allow for a 2 s power dip. Units rated at 115 V 50/60 Hz and 230 V 50/60 Hz have been designed to operate at + 10% of the rated operating voltage.

This unit would be best suited in any dental laboratory which fabricates all types of metal ceramic restorations. The 38 open programs would support the continual processing of multiple types of porcelains and alloys, but is not necessary for laboratories producing a great deal of procedures using one type of porcelain and alloy system.

Dentsply Multimat 99

The Dentsply Multimat 99 (Fig. 10) is a computerized porcelain furnace which offers 99 programmable firing cycles. This furnace is the only one on the market in which the firing platform is stationary and the entire muffle raises and lowers. This feature eliminates any possible fracturing of the porcelain due to movement of the firing platform. The oven has a large LED readout with a simple-to-use keyboard.

Calibration is accomplished automatically. The normal firing tray is replaced with one that has two electrodes protruding from the top. Silver wire is wrapped around and then between the electrodes. A cord from the side of the firing tray is plugged into a calibration jack located on the back of the furnace. The furnace will automatically raise the door and the temperature will rise until the silver melts. The oven is then automatically set at 960 °C (1760 °F) and all programs are adjusted.

Programming the the Multimat 99 is accomplished through the keyboard located on the front of the oven. Separate settings may be used to set the dry time while the muffle slowly closes and a second preheat drying time may be set with the muffle one-half inch open. The muffle will always close if

the idle temperature and the vacuum may be operated as a function of time or temperature. If the vacuum time setting is used, the temperature will reach its maximum point and hold under vacuum. Use of the vacuum as a function of temperature will allow for separate settings to close the muffle, vacuum start and stop temperature, maximum temperature and a hold time if desired.

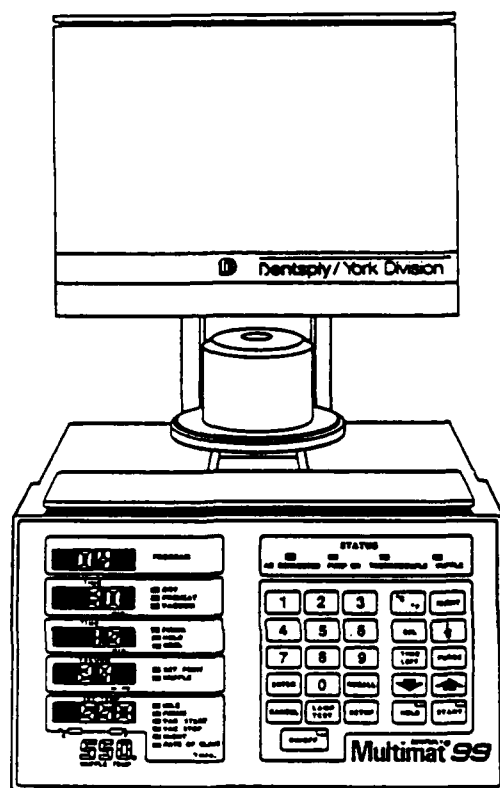


Figure 10. Dentsply Multimat 99.

If program parameters are exceeded, the display screen will go blank and new information must be input. This furnace will not alert the operator to programming errors. It is possible to set the firing hold time less than the vacuum hold time which will release the vacuum at the end of the firing hold time. If the maximum temperature is programmed lower than the vacuum stop temperature, the vacuum is released at the maximum temperature and the program is complete.

Additional features include the ability to switch from Centigrade to Fahrenheit at any time, even while a program is in progress. The automatic purging cycle will raise the temperature to 1100 °C (2010 °F), hold for 10 min under vacuum and the program is complete. Override features allow the user to depress the "HOLD" button which will allow a view of the glazed porcelain surface and permit the work to be replaced in the furnace for an additional 2 min without temperature loss. The night mode may be programmed up to 260 °C (500 °F), which will shut all functions of the furnace down and maintain the temperature until the "NIGHT" button is once again depressed.

The self diagnostics of this system is limited. Malfunction displays include muffle defects, open thermocouple circuit, and poor vacuum seal.

This unit would be best suited in any dental laboratory which uses numerous types of porcelains and alloys. The 99 open programs would support the continual processing of many types of porcelain and alloys without constantly changing program parameters. Due to the low cost of this unit it should be considered for any laboratory with a moderate to high metal-ceramic fixed partial denture work load.

New York Dental Compu-Matic CPF

The New York Dental Compu-Matic CPF (Fig. 11) is a computerized porcelain furnace with 30 open programmable firing cycles. This unit has a large LED readout with a simple-to-use keypad. The vertical muffle is a conventional ceramic type. This unit is the only one tested that will furnish a printout of all firing information.

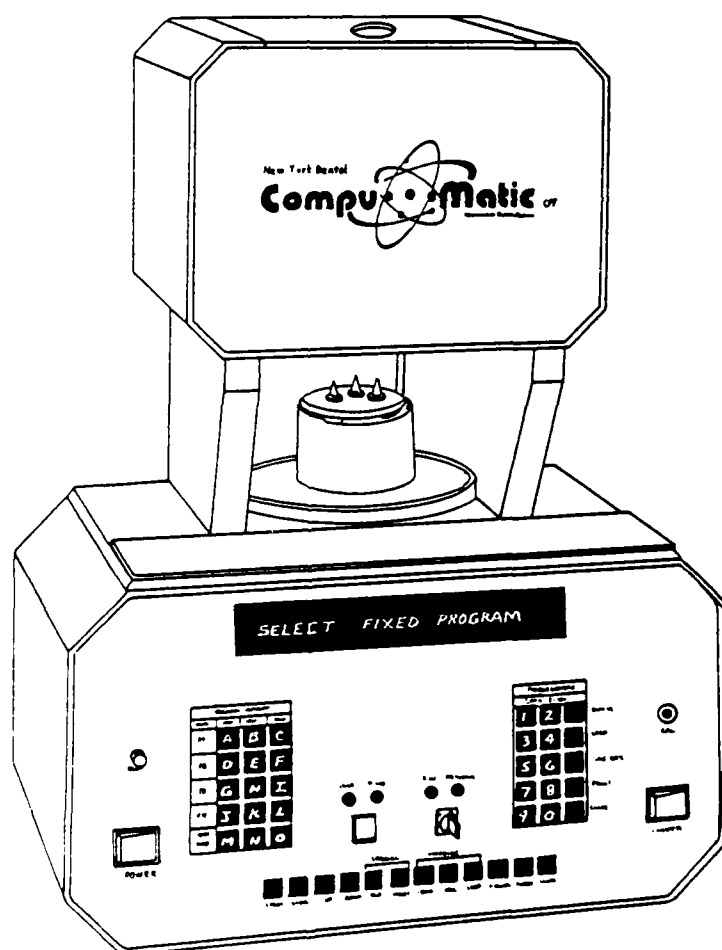


Figure 11. New York Dental Compu-Matic CPF.

Calibration is accomplished automatically. The normal firing tray is replaced with one that has two electrodes protruding from the top. Silver wire is wrapped around and then between the electrodes. A cord from the side of the firing tray is plugged into a calibration jack, the furnace will automatically raise the door and the temperature will rise until the silver melts. The furnace is then automatically set at 960 °C (1760 °F) and all programs are adjusted.

Programming of this unit is accomplished by turning a key to the "PROGRAM" mode and depressing the "STEP" key twice. All information is then easily typed into the unit following the instructions on the LED. All conventional parameters are used plus a separate drying time with the muffle door in the bottom position and one with the muffle door in the center position. Temperature rise may be set as high as 204 °C (400 °F) per minute depending on the type of furnace (two models are available: 93 °C [200 °F] or 204 °C [400 °F] per minute temperature rise). Once all parameters have been set the key is turned to the "RUN" position and all information is permanently stored in memory. Removing the key will prevent any unwanted altering of stored information. While a program is running, only the program number, temperature, and vacuum level may be viewed. A night mode is provided; however, it is unrestricted and must be programmed by the operator.

Additional features include the option of a printer (purchased separately for \$100.00). When placed in the "PROGRAM" position, a printout (Fig. 12) may be run on any stored program.

FIXED PROGRAM		A
LOW TEMPERATURE:	1200	F
DRYING TIME AT BOTTOM:	00:10	
DRYING TIME AT CENTER:	00:10	
HEATING RATE: 120	DEG/MINUTE	
VACUUM LEVEL: 27	IN. HG.	
HIGH TEMPERATURE	1750	F
RELEASE TYPE: TEMP(TIME)=1(2):	1	
RELEASE TEMPERATURE	1750	F
HIGH TEMP. HOLDING TIME:	00:10	
COOLING TIME AT CENTER:	00:10	

Figure 12. Printout.

This porcelain furnace maintains a set temperature better than any other unit tested. Once a temperature is reached it will only fluctuate ± 2 °C (± 2 °F). If repair is required, all computer chips may be removed individually while most other units require the replacement of entire circuit boards. Units may be purchased in Fahrenheit or Celsius thermometric scale, but cannot be switched back and forth.

This unit would be best suited in any dental laboratory which fabricates all types of metal ceramic restorations. The 30 open programs would support the continual processing of multiple types of porcelains and alloys, but are not necessary for laboratories producing a great deal of procedures using one type of porcelain and alloy system. The cost of this unit is far below the price of other units which are similar. A technical representative will come to each CONUS station purchasing this unit to ensure complete satisfaction.

Vita Vacumat 100

The Vita Vacumat 100 (Fig. 13) is a computerized programmable porcelain furnace with 8 open programs. This unit is very similar to the Vita Vacumat 200 with the exception of fewer open programs. The Vacumat 100 has a muffle in which the heating element is enclosed in a quartz tube. All firing information is relayed to the operator through a large LED. Programs are entered through the small keypad on the front of the unit. A vacuum pump is included in the price of the unit.

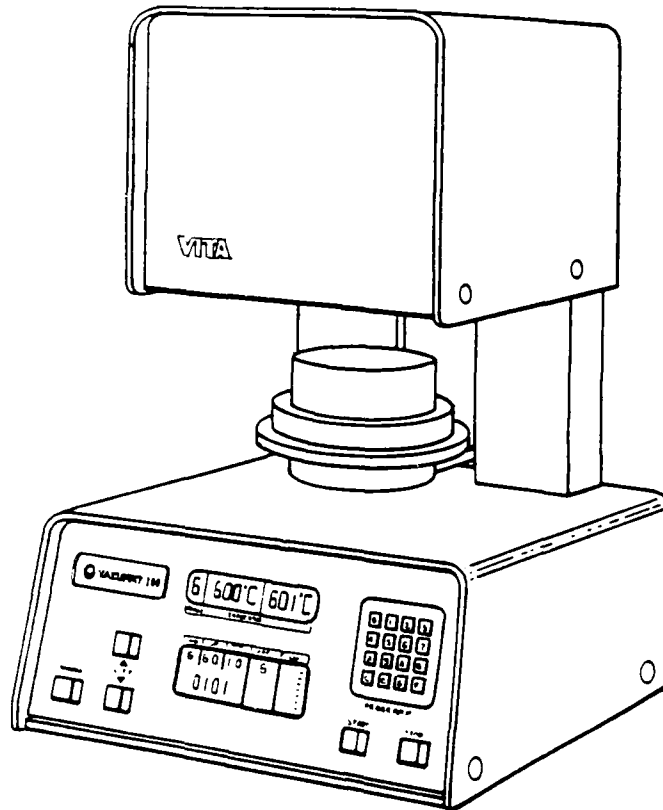


Figure 13. Vita Vacumat 100.

The muffle design of the Vita units is unique to all others on the market. Because the heating coil is completely enclosed in a quartz tube and considerably thicker than other types, there is a great reduction of thermal stress in the coil. This feature improves the durability and protects the filament from vapors and oxide formation. Because of this type of muffle design the manufacturer claims that the need for calibration is not required. The instructions for calibration are not included in the manufacturer's instructions, but may be obtained by contacting Vident. In the opinion of the evaluators this type of muffle design offered the most advantages.

All programming is accomplished through a small keypad located on the front of the unit. Inputting program data is fairly simple once the user becomes familiar with the various keys. There are 8 open firing cycles with some limitations as each program will offer a different firing sequence which

may not be altered. Example: program 1 will heat up to a given end temperature in as short a time as possible (nonprogrammable), followed by continued firing at the end temperature for a given time; program 5 will predry for a given time, then heat up to a given end temperature in a given time, all followed by continued firing at the end temperature for a given time. Programs may not be labeled within the unit.

The initial starting temperature has been factory preset at 600 °C (1112 °F). This temperature may be altered anywhere from 200 °C (392 °F) to 600 °C (1112 °F) in 50 °C (122 °F) steps by removing the internal components of the furnace and changing a switch. This feature changes the starting temperature of all the programs. With this unit there is no means for releasing the vacuum at a given temperature and raising the temperature while air firing.

Additional features include a manual control for raising and lowering the firing tray. The furnace may be rapidly cooled down following a firing cycle by using program 9. This feature drops the firing table to its lower position while the vacuum is running. The vacuum remains on until the temperature of the furnace has dropped to 50 °C (122 °F) below the idling temperature. The vacuum pump will turn itself off and the firing tray will be raised into the firing chamber.

This unit has a self-diagnostic system which monitors certain malfunctions and misprogrammings. Indicators include the programming of times and temperatures which exceed the capability of the furnace, thermocouple failure, temperature in firing chamber has exceeded 1180 °C (2156 °F), and leakage of the vacuum system.

This furnace has a unique plug for the vacuum pump which requires the use of a Vita vacuum pump which is included. The provided accessories include a firing tray, a pair of 25-cm tweezers, a power lead complete with plugs, 6 crown stands, 2 porcelain trays, operating instructions, and a firing chart.

This unit would be best suited in any dental laboratory which uses primarily Vita porcelains. The 8 open programs would support the continual processing of one or two types of porcelain and alloys without constantly changing program parameters. This unit is an excellent one but the setting of the low temperature changes the low temperature of all the programs and there is no capability to release the vacuum and raise the temperature at the end of the firing cycle. Consequently the use of some types of porcelains would require a modification of their processing.

Jelenko Commodore VPF

The Jelenko Commodore (Fig. 14) is a computerized porcelain furnace with 10 programmable firing cycles. This unit is similar to the Flagship Series B except with a reduced number of programs and no automatic purging or fixed idling cycles. This unit has a large LED readout with a simple-to-use keyboard. The vertical muffle is a conventional ceramic material which includes a viewing window with an exterior light.

Calibration is accomplished automatically. The normal firing tray is replaced with one that has two electrodes protruding from the top. Silver wire is wrapped around and then between the electrodes. A cord from the side of the firing tray is plugged into a calibration jack. The furnace will

automatically raise the door and the temperature will rise until the silver melts. The furnace is then automatically set at 900 °C (1760 °F) and all programs are adjusted.

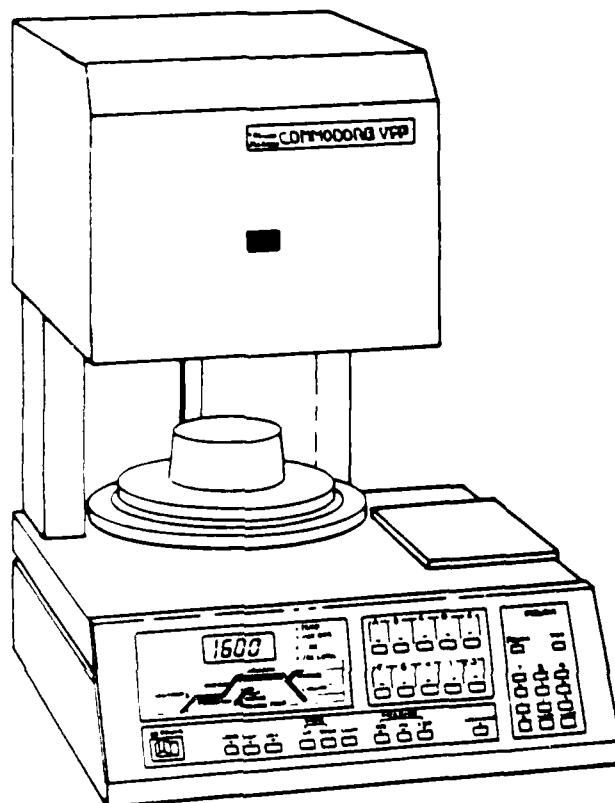


Figure 14. Jelenko Commodore VPF.

This unit is easy to program. The operator has the option to program in an evacuation temperature which will close the oven door at a given temperature and turn on the vacuum at another temperature. Information may not be automatically transferred from one program to the next as with the Flagship Series B. If at any time errors are programmed into the unit, error messages will appear and corrective action must be taken. While running a program, only temperature and vacuum readings will show up on the LED screen; however, program parameters may be viewed at any time by depressing the "PROGRAM" and "STEP" keys. All information is permanently retained and a battery backup is not required.

Additional features include an override operation. This feature allows the user, at the end of a firing cycle, to automatically close the oven door and raise the temperature an additional 37.8 °C (100 °F) with or without vacuum. In-cycle parameter changes are limited depending on how far the program has progressed. The user-created idle program allows the user to set the temperature either with or without vacuum. The automatic night program will maintain the furnace temperature at 310 °C (590 °F) and the vacuum pump will run for 1 min and then turn off. This furnace may be easily switched from Celsius to Fahrenheit which will change all the program information.

This unit has a self-diagnostic system which continuously monitors the vital functions of the furnace. Malfunction displays include CPU malfunction, malfunction of the control circuit board, excess temperature, platform malfunction, heater malfunction, vacuum malfunction, calibration malfunction, and thermocouple malfunction. The provided accessories include a set of 3 single point sagger trays, a set of 2 crown sagger trays, full arch sagger trays, calibration kit, door platform, and a manual door crank handle.

This unit would be best suited in any dental laboratory which uses one or two types of porcelain and several different types of alloys. The 10 open programs would support the continual processing of several types of porcelain and alloys without constantly changing program parameters.

Jelrus Megastar

The Jelrus Megastar (Fig. 15) is a computerized programmable porcelain furnace with 10 open programs. This unit has a video screen which shows the program number, temperature, vacuum level, and program information. The keyboard is found directly below the video screen and is easy to operate. The vertical muffle is a conventional ceramic material which offers a rapid heat-up and cool-down period.

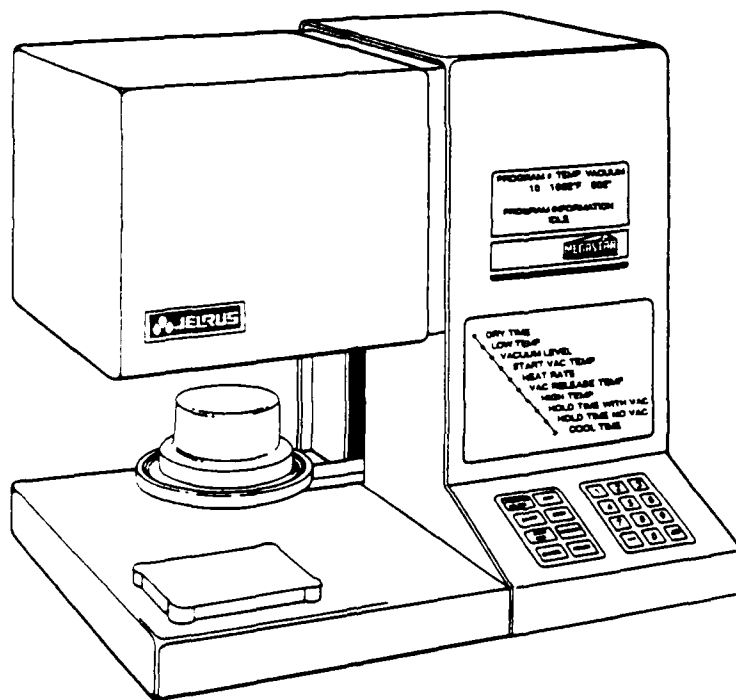


Figure 15. Jelrus Megastar.

Calibration is accomplished automatically. The normal firing tray is replaced with one that has two electrodes protruding from the top. Silver wire is wrapped around and then between the electrodes. A cord from the side of the firing tray is then plugged into a calibration jack. After the

calibration program has started, there is a 10-min heat soak period at 704 °C (1300 °F) followed by the temperature rising until the silver melts. At that point the furnace is automatically calibrated at 960 °C (1760 °F).

This unit is easy to program. The user types in the desired program and pushes the "EDIT/REVIEW" key. The correct information is typed in and the "ENTER/REVIEW" key is pushed. All parameters are then posted in logical sequence. Included in the programming options is the ability to select full vacuum, no vacuum, or any entry between 10.0 in. Hg to 28.0 in. Hg. A separate setting is provided for low temperature and start vacuum temperature. This feature allows the user to close the muffle door, raise the temperature, and start the vacuum at a given temperature. Any limits which have been exceeded are relayed to the operator for correction. Because programs may not be labeled but are only numbers (1-10), a log book is provided to aid in keeping track of program information.

Additional features include an override operation. This feature allows the user, at the end of a firing cycle, to automatically close the oven door and raise the temperature 1 degree for each time the "OVERRIDE" button is pushed. In-cycle parameter changes are limited to raising the vacuum release temperature and the high temperature. This function is accomplished by depressing the "OVERRIDE" button one time for each degree. The program number, muffle temperature, and vacuum level may be monitored throughout the firing cycle. Actual program parameters may be viewed at any time by depressing the "ENTER/REVIEW" key. The Megastar will automatically idle at 538 °C (1000 °F) unless you have selected a starting low temperature below 538 °C (1000 °F), then the oven will idle at your selected low temperature.

This unit has a very complete self-diagnostic system which continuously monitors all functions. Programming or system malfunctions appear on the video screen for corrective action. Displays include invalid entry, invalid program number, check vacuum, check door, do silver calibration, check silver wire, do vacuum calibration, power failure, check set values, open TC (faulty thermocouple), muffle/open (replace muffle), and replace Triac.

This unit would be best suited in any dental laboratory which fabricates one or two types of porcelain and several different types of alloys. The 10 open programs would support the continual processing of several types of porcelains and alloys without constantly hanging program parameters.

Unitek Ultra-Mat II Porcelain Furnace

The Unitek Ultra-Mat II (Fig. 16) is a computerized automatic porcelain furnace with 7 different firing modes. All temperature and vacuum readings are from 2 large gauges. Controls to set the low temperature, high temperature, heating rate, and timer are all located on the front of the unit. The vertical muffle is a conventional ceramic type.

Calibration is accomplished through the use of pure silver foil. Program 5 is used to slowly raise the temperature until the foil has melted. The furnace is then manually adjusted by a calibration setscrew located on the back of the unit. This procedure is difficult as the temperature must be

carefully controlled and the temperature rise must be very slow to prevent excess temperatures. In addition, the calibration setscrew has poor accessibility, and the procedures must be repeated several times to ensure accuracy.

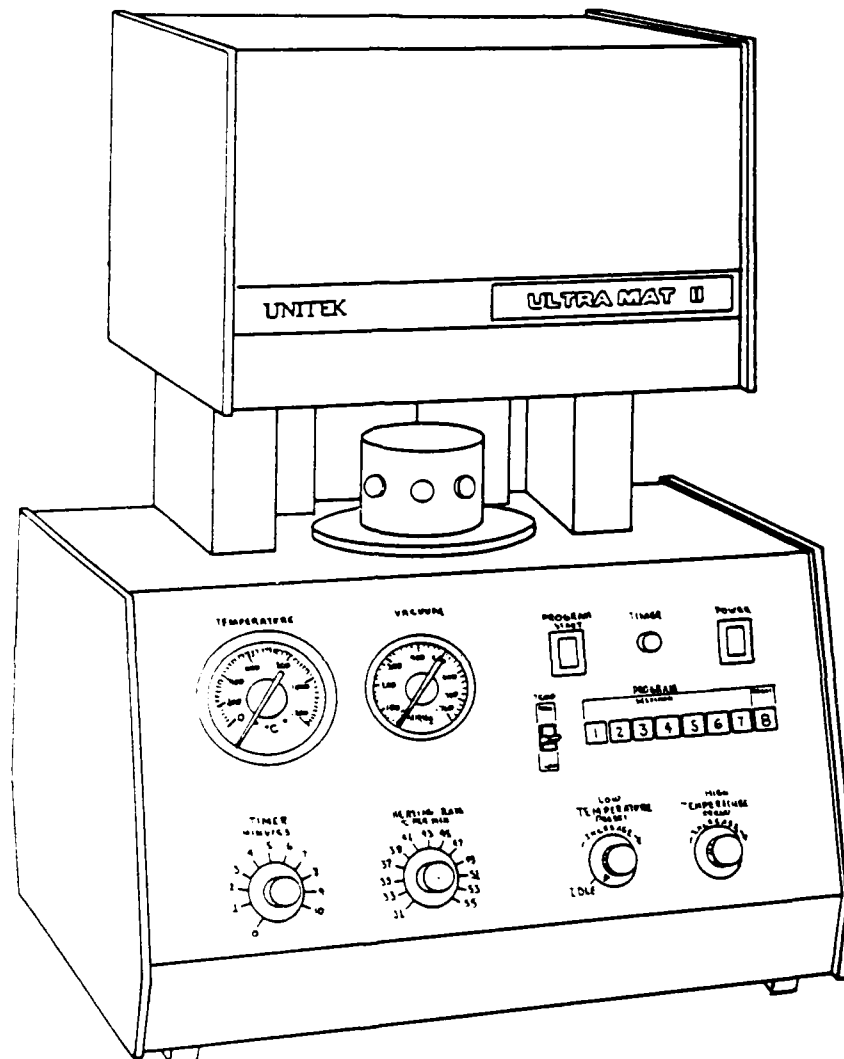


Figure 16. Unitek Ultra-Mat II.

This unit may be operated in any of 7 different programs. Each program has a set sequence of vacuum and/or air firing which may not be changed. Changes are limited to preselecting of the high- and low-temperature settings, heat rate, and time at maximum temperature. This unit does not have any memory and all gauges are read in Celsius only. All information is set by dials and gauges and must be reprogrammed any time a firing cycle is changed. Programming information which may be viewed include actual temperature and vacuum only. Low- and high-temperature set points may be checked at any time during the cycle by momentarily pressing the "LOW" or "HIGH" temperature set switches.

This unit would be best suited in any dental laboratory which uses one type of porcelain and several different types of alloys. The 7 open programs would support the fabrication of all types of metal ceramic restorations; however, program parameters have to be constantly changed as this unit has no memory.

Jelrus Cera-Mat S

The Jelrus Cera-Mat S (Fig. 17) is a manual porcelain furnace. The gauges and dials are all located on the front of the unit. The manual door lift knob is located on the right side of the unit. The vertical muffle is a conventional ceramic type.

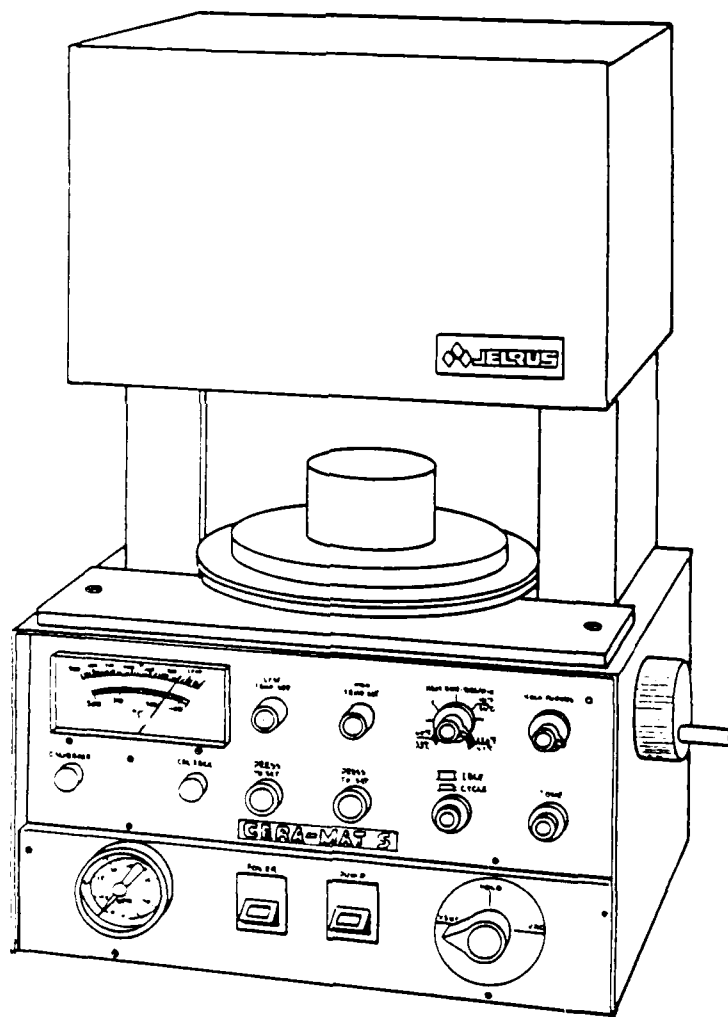


Figure 17. Jelrus Cera-Mat S.

Calibration of this unit is carried out by replacing the normal firing tray with one that has two electrodes protruding from the top. Silver wire

is wrapped around and then between the electrodes. A cord from the side of the firing tray is then plugged into a calibration jack. The oven door is closed and the furnace placed in the cycle mode. When the tone sounds, the silver has melted and the calibration control is turned to read 960 °C (1760 °F). Note: The calibration tray is not included with the oven and must be ordered separately.

This unit is operated by setting the low and high temperature, slowly closing the firing tray, and depressing the idle/cycle switch, vacuum may be applied if desired. A short tone will sound when the temperature is 37.8 °C (100 °F) from the set high temperature, alerting the operator to release the vacuum if desired. Once the high temperature is reached the timer, if set, will be activated and a tone will sound when the cycle has finished.

This unit would be best suited for any small production laboratory or for a remote area without laboratory support. The unit is simple to operate and allows the technician/dentist to fabricate metal ceramic restorations, perform add-ons, glaze, or post-soldering.

Jelenko Tru-Fire VPF

The Jelenko Tru-Fire (Fig. 18) is a manual porcelain furnace. This unit has a bright LED readout for the temperature and vacuum. All buttons are located on the front of the unit for easy access. The vertical muffle is a conventional ceramic type.

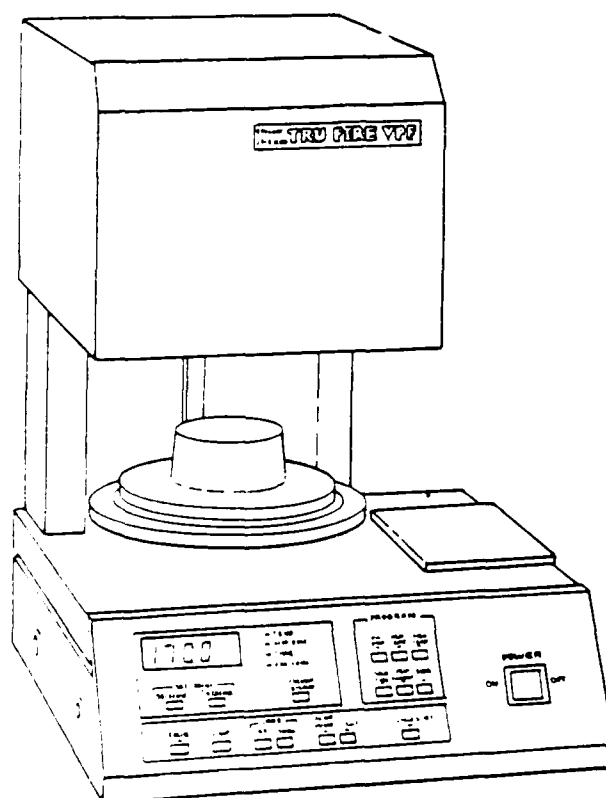


Figure 18. Jelenko Tru-Fire VPF.

Calibration is accomplished automatically. The normal firing tray is replaced with one which has two electrodes protruding from the top. Silver wire is wrapped around and then between the electrodes. A cord from the side of the firing tray is then plugged into a calibration jack. The unit will automatically raise the door and the temperature will rise until the silver melts. The furnace is then automatically set at 960 °C (1760 °F) and all programs are adjusted.

This unit is operated by manually setting each program parameter, raising the oven door, and depressing the cycle start button. The idle temperature is automatically the low temperature setting, and separate settings for releasing vacuum and raising the temperature are possible. Temperature settings are changed by depressing a button until the desired temperature is reached. Vacuum and temperature readings may not be read simultaneously.

The unit has a self diagnostic system which continuously monitors the vital functions of the unit. Malfunction displays include CPU malfunction (malfunction of the control circuit board), excess temperature, heater malfunction, vacuum malfunction, calibration malfunction, and thermocouple malfunction.

This unit would be best suited in a small production laboratory or a remote area without a laboratory; however, there are limitations. Because a manual furnace does not have a memory, programs must be changed constantly. With this type of furnace program parameters may not be easily viewed, which means constantly changing and checking firing information.

Ney Mark III

The Ney Mark III (Fig. 19) is a manual porcelain furnace. This unit uses dials and gauges and has an automatic optical pyrometer that will indicate the muffle temperature and control the preset temperature within a 1% tolerance. The muffle is a horizontal conventional ceramic type.

Calibration of this unit is carried out manually. Silver tabs are placed in the muffle, and the temperature is slowly raised until the silver melts. Once this procedure has been visually observed the calibration screw is turned to 960 °C (1760 °F). An optional large-view glass may be purchased for the muffle door, which will allow for increased visibility.

The use of the unit is completely manual with the exception of an automatic timer which may be used at the end of a cycle. The rate of temperature rise is set by use of an ammeter and voltmeter while the temperature gauge reads out in Fahrenheit or Celsius thermometric scale. Four types of muffles are available for this unit with heat ranges from 1149 °C (2100 °F) to 1454 °C (2650 °F).

This unit would be best suited for any small production laboratory or for a remote area without laboratory support. It is easy to operate, allowing the dentist/technician to fabricate all types of metal ceramic restorations, perform sinter cycles, and glaze or post-solder. In addition, if high temperatures are required, as in the use of the all-ceramic material Vita Hi-Ceram, high-temperature muffles are readily available and simple to change.

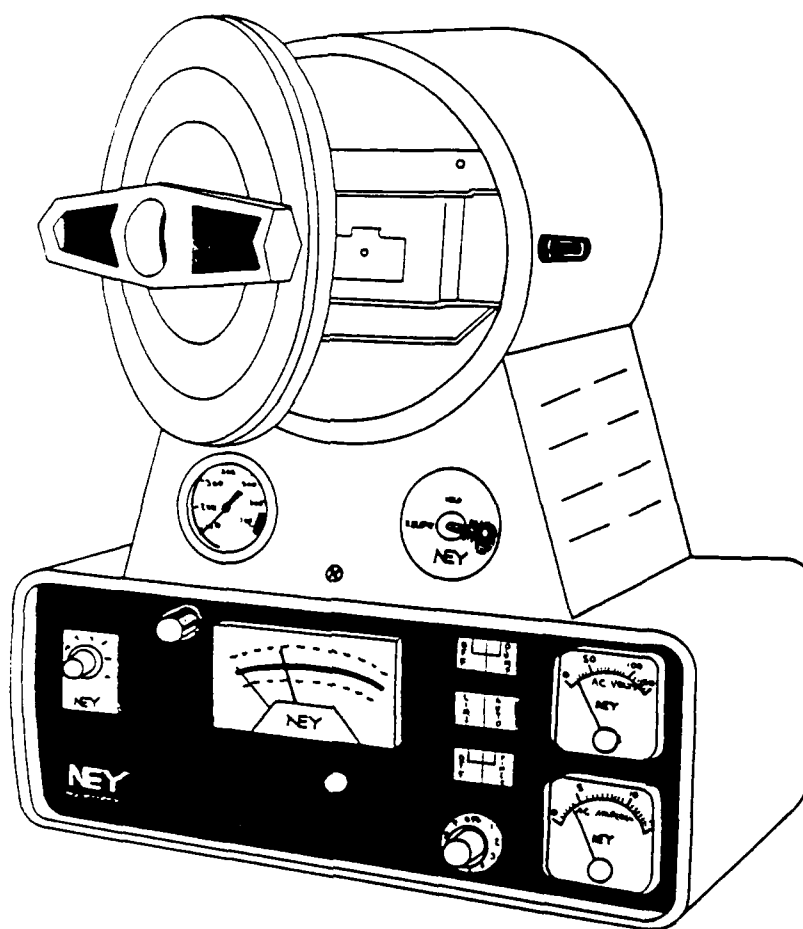


Figure 19. Ney Mark III

Ney Model 660

The Ney Model 660 (Fig. 20) is a manual porcelain furnace. This unit is similar to the Ney Mark III except it does not include the voltmeter, ammeter, or automatic timer. The unit uses dials and gauges which are located on the front of the unit. The muffle is a horizontal conventional ceramic type.

Calibration of this unit is carried out manually. Silver tabs are placed in the muffle, and the temperature is slowly raised until the silver melts. Once this procedure has been visually observed the calibration setscrew is turned to 960°C (1760°F). An optional large-view glass may be purchased for the muffle door, which will make it easier to see when the silver has melted.

The use of the unit is completely manual. The rate of climb is set by use of a small gauge while the temperature gauge reads out in Fahrenheit and Celsius. Four types of muffles are available for this unit with heat ranges from 1149°C (2100°F) to 1454°C (2650°F).

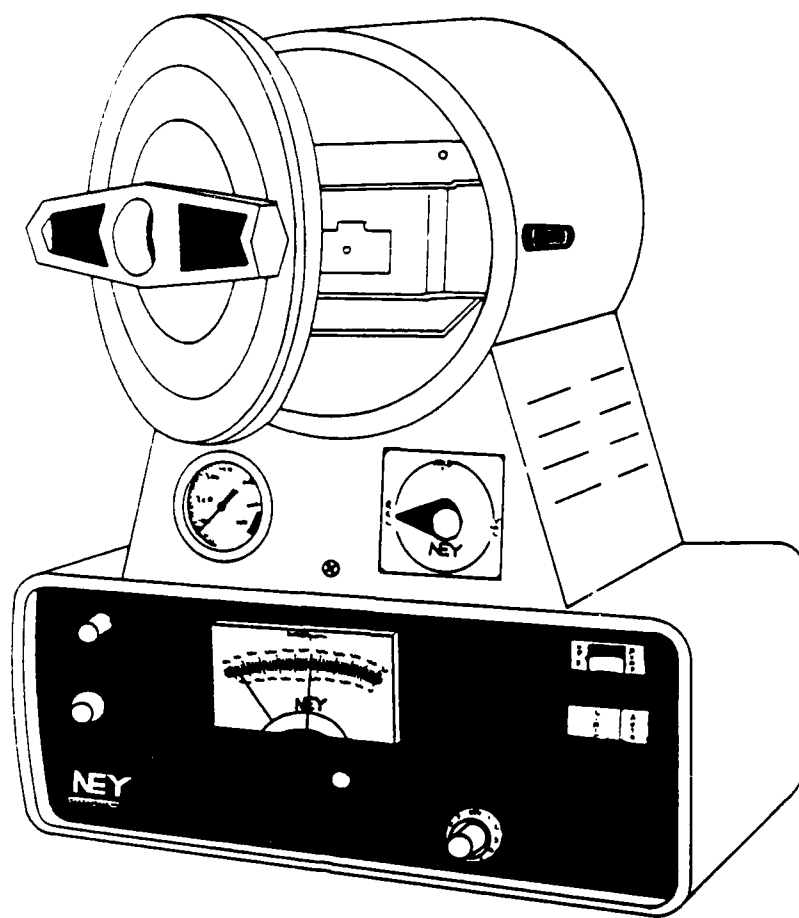


Figure 20. Ney Model 660.

This unit would be best suited for any small production laboratory or for a remote area without laboratory support. The unit would be ideal for any dental clinic without porcelain-fused-to-metal support. A unit such as this would allow for accurate glazing and add-on cycles.

Jelrus Glaze-A-Mat

The Jelrus Glaze-A-Mat (Fig. 21) is a manual glazing furnace. All operations are conducted through the use of dials and gauges which are located on the front of the unit. An arm, which is located on the side of the unit, is used to raise and lower the units into the oven. The vertical muffle is a conventional ceramic type.

Calibration of this unit is carried out by replacing the normal firing tray with a tray which has two electrodes protruding from the top. Silver wire is wrapped around and then between the electrodes. A cord which protrudes from the side of the firing tray is then plugged into a calibration jack. The oven door is then closed and the temperature is raised. When the tone sounds, the silver has melted and the calibrate control is turned to read 980 °C (1760 °F). Note: The calibration tray is not included with the unit and must be ordered separately.

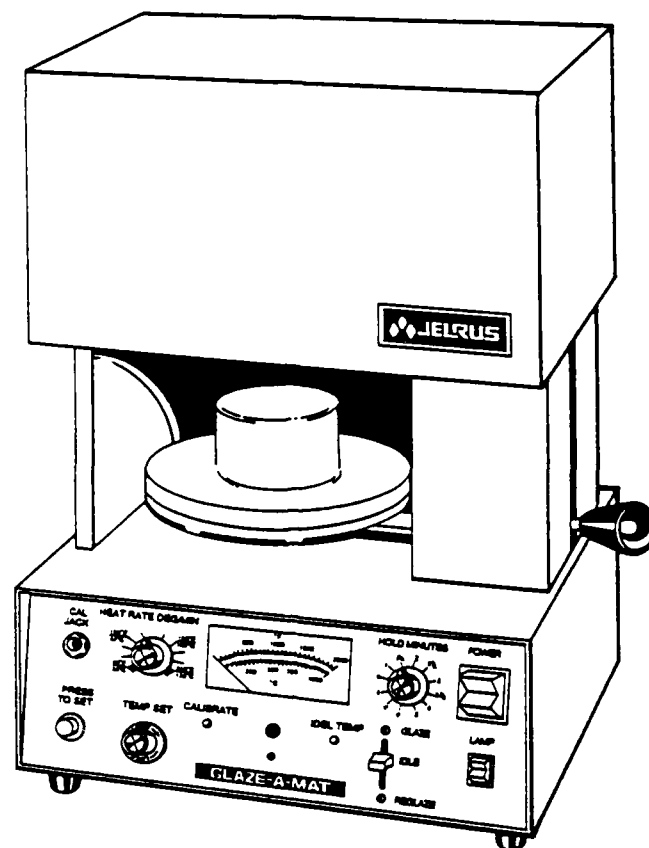


Figure 21. Jelrus Glaze-A-Mat.

This unit is easy to operate. The high temperature is set by depressing a button and turning a dial. The heat rate may be set anywhere from 15.5 °C (60 °F) to 116 °C (240 °F) per minute and a hold time may be used at the end of the cycle. The idle temperature has been set at the factory at 649 °C (1200 °F) but may be changed if desired. A tone will alert the operator -9 °C (15 °F) before the end of a cycle.

This unit would be best suited for any dental laboratory/clinic which would have a need for glazing only. This unit has more features than any other glazing furnace on the market, which would help to ensure accurate glazing procedures.

Jelenko Auto Glazer

The Jelenko Auto Glazer (Fig. 22) is a manual glazing furnace. All gauges and dials are located on the front of the unit, and the temperature may be read in Fahrenheit or Celsius thermometric scale. The knob for raising and lowering the firing table is located on the side of the unit. The vertical muffle is a conventional ceramic type.

Calibration of this unit is accomplished by placing a silver tab in the furnace, raising the temperature until the silver melts, and manually adjusting the temperature with a setscrew located on the rear of the unit. This

process required the user to continually open and close the oven door, as the melting process may be not observed any other way. This method is sensitive and may not result in extremely accurate calibrations.

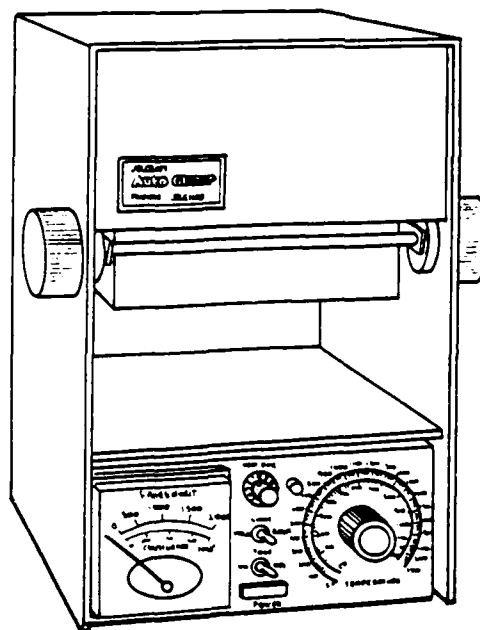


Figure 22. Jelenko Auto Glazer

Operation of this unit involves turning the temperature dial and heat control to the desired setting, placing the "HOLD, LIMIT, RESET" switch to the desired setting, and turning on the "TONE" switch if desired. Use of the "HOLD" setting will maintain the temperature of the furnace at the maximum temperature indefinitely as there is no timer. Note: Internal muffle size is rather limited with a height of 2.54 cm.

This unit would be best suited for a dental laboratory/clinic which would have a need for a glazing only. However, this unit does have its limitations. Calibration is rather difficult; there is no automatic timer and muffle height is limited.

Ney Miniglaze/2

The Ney Miniglaze/2 (Fig. 23) is a manual glazing furnace. All gauges and dials are located on the front of the unit, and the temperature may be read in Fahrenheit or Celsius thermometric scale. The horizontal muffle is a conventional ceramic type.

Calibration of this unit is accomplished by placing a silver tab in the furnace, raising the temperature until the silver melts, and manually adjusting the temperature with a setscrew located on the front of the unit. The accuracy of this process would be greatly enhanced if the optional Clear Vue Muffle Door would be used.

Operation of this unit involves turning the temperature dial heat control to the desired position and turning the "LIGHT/TONE" switch to the desired setting. Use of the "LIGHT/TONE" switch will allow for either an audible indicator or a light to come on once the maximum temperature has been reached.



Figure 23. Ney Miniglaze/2.

This unit would be best suited for a dental laboratory/clinic which would have a need for glazing only. However, this unit does have its limitations. Calibration may be difficult, as visibility is limited and there is no automatic timer.

VACUUM PUMP EVALUATION

Ney Super-Vac Pump

The Ney Super-Vac is extremely quiet and could not be heard over ambient room noise. This pump was rather slow, taking approximately 50% longer to achieve maximum vacuum than other pumps tested. The Super-Vac would work on any unit allowing a traditional 3-prong plug. Maintenance includes changing the oil once a month using 15 oz of Ney Super-Vac Pump Oil.

New York Dental Vacuum Pump

The New York Dental vacuum pump is very quiet, and sound levels were below the capabilities of our instrument. Maximum vacuum was easily achieved in a minimum time. This vacuum pump would work on any unit allowing a traditional 3-prong plug. Maintenance includes changing the oil every 6 months with a lightweight oil.

Vita Vacuum Pump

The Vita vacuum pump is oilless and requires no regular maintenance. Because this pump has a unique plug, it may only be used on Vita porcelain furnaces. This unit was the quietest of the oilless pumps tested with a rating of 50 dB after 1 min. This feature may be an important factor, as the pump will run constantly throughout the firing cycle.

Dentsply Vacuum Pump

The Dentsply vacuum pump is extremely quiet and could not be heard over ambient room noise. This pump would work on any unit allowing a traditional 3-prong plug. Maintenance includes changing the oil once a month using 10 oz of Dentsply Vacuum Pump Oil.

Jelrus Vacuum Pump

The Jelrus vacuum pump is oilless and requires no regular maintenance. This pump would work well on any porcelain furnace allowing a traditional 3-prong plug. It has a 66 dB rating.

Unitek Vacuum Pump

The Unitek vacuum pump is oilless, and maintenance is limited to removing any water that accumulated in the moisture collector bulb. This pump has a rating of 66 dB and would work well on any furnace allowing for a traditional 3-prong plug.

Jelenko Jelcraft Pump

The Jelenko Jelcraft is an oilless vacuum pump. Maintenance includes a monthly check of the chamber in the head to be sure it is free of accumulations of liquids. This step is done by removing 5 screws on the top of the unit and the plate and gasket. This pump was rated at 61.8 dB and would work well on any furnace allowing a conventional 3-prong plug.

DISCUSSION

Purchasing Factors

The number of porcelains and alloys which a dental laboratory uses will help to determine what size of programmable porcelain furnace to purchase. Dental laboratories with a heavy workload using many different porcelain metal systems should consider the Jelenko Flagship II, Unitek Ultra-Mat CDF, Jelrus Alpha PC, Vita Vacumat 200, Ney Sun Fire/40, Jelenko Flagship Series B, Dentsply Multimat 99, and the New York Dental Compu-matic. The Vita Vacumat 100, Jelenko Commodore, Jelrus Megastar, and Unitek Ultra-Mat II are programmable furnaces which would support laboratories with a heavy workload using one or two porcelain metal systems.

The workload of a dental laboratory will determine whether to purchase a programmable or manual porcelain furnace. Small ceramic sections or areas requiring a furnace for glazing and add-ons should consider a Jelrus Cera-Mat-S, Jelenko Tru-Fire, Ney Mark III, and Ney Model 660.

Areas which are sure that only glazing will be needed should consider the Jelrus Glaze-A-Mat, Jelenko Auto Glazer, or Ney Mini Glaze.

The type of porcelain used should be a consideration when purchasing porcelain furnaces. Some units such as the Vita Vacumat 200 and Vita Vacumat 100 will work on any porcelain metal system but are designed primarily for Vita porcelain. Full porcelain restorations such as the Vita Hi-Ceram require a maximum firing temperature of 1170 °C (2138 °F), which may be above the maximum firing temperature of some muffles. Units which meet or exceed this temperature include the Unitek Ultra-Mat CDF (requires an additional computer chip), Jelrus Alpha PC, Dentsply Multimat 99, Vita Vacumat 200, Vita Vacumat 100, Unitek Ultra-Mat II, and the Ney Mark III and Model 660 (depending on the muffle purchased).

All manufacturers require the use of a dedicated line with a minimum amperage. Before ordering a furnace, always be sure that your electrical system will support a new piece of equipment.

Other porcelain furnaces tested include the Oxy Micro Ten which is manufactured through E&D Dental Manufacturing. This unit was extremely sensitive to outside electrical interference and should not be considered for selection.

CONCLUSION

The selection of porcelain furnaces will depend on the needs of the respective dental clinic and laboratory technician. All units tested essentially performed the tasks for which they were designed.

The information provided by this report can be used by base dental surgeons as an aid in purchasing dental porcelain furnaces. Any questions should be directed to the U.S. Air Force Dental Investigation Service, USAFCDAM/NGD, Brooks AFB, TX 78235-5301, AUTOVON 240-3502, Commercial (512) 536-3502.

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